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ABSTRACT

A study was carried out to investigate the effects of inducing bilinguals to use both of their languages to read, study, and recall information from a passage of expository text. The subjects were 80 French-English bilinguals who read a passage in either English or French and took notes in either language. They then completed tests of free recall and inference in French or English. The interaction of language of reading, language of note-taking, and language of recall and its effects on the quality of recall were of particular interest in the study. Results indicated that, contrary to expectation, varying the language in which the passage was read, studied, and recalled failed to influence either the amount of information recalled or the ability to draw inferences based on the reading. However, the subjects had more confidence in their recall when the text was presented in their native language even when their performance on the two language versions did not differ significantly. Based on these results, it is proposed that the same ideas expressed in two languages are not stored separately but in a unified semantic component, a finding in basic accord with previous research on bilingual memory. References, tables, and figures are appended. (MSE)

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Multilingual Referents in Cognitive Processing

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Running head: MULTILINGUAL REFERENTS

Abstract

The effects of inducing bilinguals to use both of their languages to read/study and recall information from a passage of expository text were investigated. Eighty French-English bilinguals read a passage written in either French or English, and took notes on the passage in either French or English. Subjects then completed a test of free recall and an inference test, both of which were administered in French and in English. Contrary to prediction, varying language of text, notes and recall did not produce differences between groups in amount of information remembered. However, subjects believed that they remembered more when text was presented in their native language. Results were interpreted in terms of the interdependence model of bilingual memory.

Multilingual Referents in Cognitive Processing

A critical issue in bilingualism, as well as cognitive psychology in general, concerns how language is related to conceptual knowledge. Bilinguals, by virtue of having multiple linguistic referents available through which knowledge may be acquired, represented, and expressed, provide cognitive scientists with a particularly intriguing population for investigating links between language and thought. The purpose of the present study was to examine one facet of the more general question of how language and thought interact--namely, how recall of text is influenced by inducing bilinguals to use both of their languages to process and recall information. This question also has practical implications in that it relates to the controversial debate concerning how to teach bilinguals. In many cases, educational programs for bilingual children have required that only one language be used as the medium of instruction. The present study, on the other hand, addressed the question of whether using both of a bilingual's languages to read and study school-like material enhances or impairs comprehension.

Previous research pertaining to whether and how a bilingual's two languages interact at the time of storage in, or retrieval from, memory has dealt primarily with recall of single words (cf., McCormack, 1977). When researchers have examined bilinguals' processing of meaningful verbal material, they have focused either on (a) bilinguals' ability to recall the original language in which

stimuli were presented (cf., Rose, Rose, King, & Perez, 1975), or (b) identification of specific, isolated reading skills which differentiate native from non-native users of the language (Favreau & Segalowitz, 1982). Consequently, we know that fluent bilinguals who read a text written in their first, as opposed to their second, language are better able to utilize various orthographic (Favreau, Komoda, & Segalowitz, 1980), syntactic (Macnamara, Feltin, Hew, & Klein, 1968), and semantic redundancies (Cziko, 1978). We also know that it is highly unlikely that people who are equally fluent in two languages code-switch between languages while reading (Blair & Harris, 1981; Macnamara & Kushnir, 1971). We can surmise, based on anecdotal reports, that given a passage in French, a French-English bilingual probably will not translate that passage into English in order to more fully comprehend it. What we don't know is whether or not performing such a translation or reorganization of the text into the alternate language might enhance a bilingual's comprehension of information contained in that text. Hence, one of the questions that this study sought to answer was: Would differences in recall (in both languages) be found between bilinguals who used both of their languages to read/study/encode information from a passage of text and those who used only one of their languages to perform the same task?

In order to answer this question, French-English bilinguals were asked to read a passage written in either French or English, and to take notes on the passage in either French or English.

Notetaking was chosen as the encoding strategy on the basis of its tendency to prompt learners to transform, reorganize, and elaborate on information-to-be-remembered (Peper & Mayer, 1980). Subjects then took two tests, both administered in both French and English (or vice versa), based on information contained in the passage. The first involved writing down everything they remembered from the passage, whereas the second tapped their ability to draw inferences based on what they had read.

Previous research concerning bilinguals' processing of text information provided little guidance concerning the probable effects of this manipulation. The few studies that have examined bilinguals' comprehension of complex verbal information as a function of language of presentation and language of recall have yielded conflicting results (Keats & Keats, 1974; Kolers, 1966; Ojerinde, 1982). Moreover, these investigators did not examine how recall of text information was influenced by using two languages at the time of encoding, although other researchers investigating the effects on recall of translation versus repetition of single words have reported that using two languages to process information produces additive effects on recall (Glanzer & Duarte, 1971; Paivio & Lambert, 1981). The present study, therefore, (a) extended previous research on bilinguals' recall of text as a function of the relation between language of text and language of recall by varying the language in which an overt study strategy--notetaking--was carried out, and (b) sought to determine whether use of an encoding activity which required

translation would produce the same facilitative effects for recall of text as had been reported previously for single words.

Based partly on the results of the Paivio and Lambert (1981) study in which recall was significantly enhanced for single words which had been translated, rather than simply copied during presentation, it was expected in the present study that bilinguals who read the text in one language and took notes on it in their alternate language would remember more information overall, regardless of language of recall, than their counterparts who read and took notes all in the same language. Additional support for this prediction derived from two sources. First, both the encoding variability hypothesis (Martin, 1968) and organization theory (see Shimmerlik, 1978, for a review) suggest that encoding information in two different contexts, or via two organization schemes, will result in a greater number of retrieval cues, and, thus, greater accessibility of encoded information at the time of retrieval. Hence, to the degree that each of a bilingual's languages can be viewed as a separate and distinct scheme through which incoming information can be organized, it was expected that reading the text in one language and taking notes in the alternate language would facilitate comprehension and recall of text information.

Second, reading and encoding in two languages involves the extra step of translation. Operating on the assumption that translation requires "deeper," or at least more extensive, processing, the notions of levels of processing (Craik & Lockhart,

1972), elaboration (Craik & Tulving, 1975), and distinctiveness of encoding (Jacoby, Craik, & Begg, 1979) all led to the prediction that subjects who used two languages to process the same information would remember more of that information than subjects who used only one of their languages. As Glover, Bruning, and Plake (1982) have pointed out, "information or processes that stand out against a background or that require greater levels of reader involvement are apt to be more memorable than background information, or information requiring little reader involvement" (p. 533). Consequently, it was expected that subjects who took notes in the alternate language from that in which text was presented would recall more of those notes than subjects who took notes in the same language in which text was presented. Moreover, based on the work of Glover et al. (1982), it was expected that reading and taking notes in alternate languages would enhance recall not only of information on which notes were taken, but also of associated information in text.

The next prediction dealt with the nature of the interaction between language of text and language of recall. Based on the encoding specificity hypothesis (Tulving & Thomson, 1973), it was expected that recall would be higher when subjects read and were tested in the same, as opposed to alternate, languages.

Of particular interest in this study was the nature of the three-way interaction involving language of text, notes, and recall. Here the focus was on whether recall (for those subjects for whom text and notes were in alternate languages), would be better if it

occurred in the same language as that in which text was read, or rather if it occurred in the same language as that in which notes were written.

Method

Design

The design was a 2 (language of text) x 2 (language of notes) x 2 (language of recall) mixed factorial with repeated measures on the language of recall factor. Two factors, language of text (French vs. English) and language of notes (French vs. English) were manipulated between subjects to form four experimental cells, with language of recall (French vs. English) serving as a within-subjects factor across each cell.

Subjects

Eighty French-English bilinguals, 16 females and 64 males, served as subjects. Forty-three subjects were commissioned officers stationed at the BFC St. Jean military installation, while 37 subjects were enrolled in the College Militaire Royale de St. Jean (a bilingual military college). Both settings are located in St. Jean-sur-Richelieu, Quebec, Canada.

Prior to the experimental session, subjects' scores on the Canadian Department of National Defense Proficiency Test were obtained. Only those subjects with "very good" or "excellent" proficiency in both French and English, as indicated by scores on the reading subtest, were selected for participation in the study. Subjects were then blocked by setting. Once blocked, they were assigned

randomly from each block to each of the four experimental conditions in such a manner that each cell of 20 subjects contained approximately equal numbers of participants from the two settings.

Within each cell, five subjects were assigned randomly to each of four counterbalanced language of recall order sequences. Experimental materials, in multiples of 16 (four sequences x four treatment conditions), were shuffled and stacked prior to the experimental session. Materials were distributed to subjects from this randomly ordered stack.

Materials

Balance measure. Reading subtest scores from the Department of National Defense Proficiency Test provided a measure of subjects' "balance" in the two languages. The test assesses degree of bilingualism in oral speaking, listening, reading, and writing.

Text. Expository text was an adaptation of a magazine article entitled "Mood Food" (Wallace, 1984) which describes the effects of specific foods on peoples' thoughts, feelings, and behavior. The readability of the passage is approximately 12th grade (Fry, 1972). A French-born, professional translator translated the passage, as well as all other experimental materials, into French. The translated version was then checked for accuracy by a second, professional translator. The English version of the passage contained 653 words and 37 sentences, while the French version contained 785 words and 37 sentences. The discrepancy in the number of words contained in the two versions was due largely to gender markings preceding nouns

in the French version. When these markings were not included in the word count, the discrepancy was reduced to 653 vs. 693 words in the English and French versions, respectively. Double-spaced, typed copies of the passage were duplicated on 8½ x 11 in. (21.59 x 27.94 cm) white paper for use in the study.

Sixteen French-English bilinguals drawn from the same pool of subjects as those used in the main experiment divided both the English and French versions of the passage into subunits using a modification of Johnson's (1970) technique for dividing "complex verbal materials into linguistic subunits possessing psychological significance" (p. 12). On the first day of passage norming, eight subjects subdivided the French version of the passage, while eight others subdivided the English version. On the following day, subjects subdivided the alternate language version of the passage they had received the previous day.

All raters were instructed to divide the text into locations which were "psychologically acceptable" for pausing. Following Johnson (1970), raters were advised that whereas some subunits could be intact sentences, other subunits might occur within sentences or within other subunits. Instructions accompanying the English version of the passage were written in English, whereas those accompanying the French version were written in French.

Mean number of subunits identified by raters were 78.25 (SD = 20.89) and 76.38 (SD = 25.49) for the English and French versions of the passage, respectively. These data were entered into a one-way

repeated measures ANOVA. There was no significant difference between number of subunits identified as a function of the language in which the passage was written.

For each version of the passage, the validity of a pausal location was accepted when a majority of raters divided a particular group of words in exactly the same way. In those cases where no group of words was divided consistently in the same manner by at least 8 of the 16 raters, the final subunit chosen was the one subdivided in the same way by the largest number of raters. Results of this procedure yielded 80 and 79 linguistic subunits for the English and French versions of the passage, respectively. Further inspection of the subunit ratings revealed that the two versions of the passage were approximately equivalent in terms of the proportion of each of the three types of subunits identified (e.g., intact sentences).

Notes. A single, 8½ x 11 in. (21.59 x 27.94 cm) sheet of white, lined paper was provided for notetaking. Directions instructed subjects to use all of the lines provided to write down passage information which they considered important. Subjects in the "English notes" condition were instructed to write their notes in English, while those in the "French notes" condition were instructed to write their notes in French.

Free recall. Two sheets of 8½ x 11 in. (21.59 x 27.94 cm) white paper were provided for the free-recall task in each of the two languages. Directions instructed subjects to write out everything

they remembered from the passage. Subjects were encouraged to try to recall the passage in as close to its original form as possible, but to give the "gist" if they were unable to recall exact sentences. Directions on one of the free-recall sheets stated that recall must be written in English. Directions on the other free-recall sheet stated that recall must be written in French.

Inference test. Two of the authors generated 17 true-false items designed to measure subjects' ability to draw inferences based upon information presented in the passage. That is, items were constructed so as to require subjects first to integrate passage information, and then to draw logical conclusions based on that information in order to determine whether a particular sentence was true or false. One of the items was: "Eating chocolates is more likely to cheer you up if you are depressed than to help you do well on tests." Pilot-testing of the items resulted in dropping (a) seven items which failed to discriminate between a sample of undergraduates who had or had not read the passage prior to taking the test, and (b) four items which had negative and/or low discrimination indices. The final, six-item version of the test had a mean difficulty of 68%, and a mean discrimination index of .50.

The order of presentation of the six questions on both the English and French versions of the inference test was then randomized. In addition, the final version of the test contained a five-point Likert rating scale under each item which asked subjects to rate their degree of confidence in the correctness of their response.

Both language versions of the inference test were typed separately on 8½ x 11 in. (21.59 x 27.94 cm) white paper for use in the study.

Procedures

Subjects, in classroom groups of 8 to 25, participated in one 60-minute experimental session. One female experimenter conducted all sessions. All treatment conditions were present in approximately equal numbers in each group.

When all subjects were present, they were told that the purpose of the study was to examine whether different types of study strategies were more effective than others in helping people to understand and remember more from what they read. The experimenter informed subjects that they would be given a passage to read, and that they would be tested on information presented in the passage. No additional information was provided concerning the exact nature of the tests. Subjects in the English notes condition were instructed to use the lined paper attached to the passage to take notes in English. Subjects in the French notes condition were given exactly the same instructions, with the exception that they were instructed to take notes in French. Directions for the task were written in both French and English, and the order in which the two versions of the directions appeared was counterbalanced across subjects. When subjects finished reading the instructions, they were told to begin reading the passage. The experimenter reminded subjects that they would be given 15 minutes to read and take notes on the passage.

Once subjects had finished this task, they were given 15 minutes to complete the first language version of the free-recall task. Following this, subjects were given an additional 15 minutes to complete the second version of the free-recall task in their alternate language. Directions on each recall sheet were written in both French and English, and the order of the language in which instructions appeared was counterbalanced across subjects.

Once subjects had completed the second free recall, the first version of the inference test was administered. Directions for each version of the inference test were written in the same language in which the items appeared. Subjects were told that they would have 5 minutes to complete the test. After completing the first version of the inference test, subjects began work on the alternate-language version of the test.

Results

One person, blind to experimental condition, scored all responses to both language versions of the free-recall and inference tests. Free-recall protocols of 10 subjects selected randomly from each experimental condition were rescored by two other persons, also blind to experimental condition and trained in the scoring procedures. Correlations between scores obtained for the 40 subjects rescored were .98 (range .96 to 1.00) for the French responses, and .96 (range .93 to 1.00) for the English responses.

Preliminary Analyses

Age. Subjects' ages were entered into a 4 (Group) ANOVA. There were no significant differences in age among subjects in the four groups.

Degree of bilingualism. Scores on the reading subtest of the Department of National Defense Proficiency Test were entered into a 4 (Group) ANOVA. There were no significant differences in reading scores among groups.

Primary Analyses

Free recall. Free recalls were scored for proportion of idea units produced. The 79 idea units identified by norming subjects in the French version of the passage were used to score responses written in French, whereas the 80 idea units identified by the same subjects in the English version were used to score responses written in English. One point was awarded for each semantically consistent rendition of an idea unit present in the original passage. Analysis of the relationship between means and variances in the groups indicated that an arc sine transformation of the proportional data was not required (Winer, 1971). Means and standard deviations for proportion of idea units produced on free recall as a function of language of text, notes, and recall appear in Table 1.

Insert Table 1 about here

Free recall data were entered into a 2 (language of text) x 2 (language of notes) x 2 (language of recall) mixed-model ANOVA. The results of this analysis yielded no significant effects.

Inference test. Inference tests were scored by awarding one point for each item correct. Means and standard deviations for number of items correct by language of text, notes, and recall are presented in Table 1.

Inference test data were entered into a 2 (language of text) x 2 (language of notes) x 2 (language of recall) mixed-model ANOVA. None of the main effects nor interactions were significant.

Confidence ratings. Confidence ratings for each item were summed for each language version of the inference test. The mean confidence rating for each version of the test was then computed. Means and standard deviations for mean confidence rating on the inference test as a function of language of text, notes, and recall are displayed in Table 2.

Insert Table 2 about here

Confidence rating data were entered into a 2 (language of text) x 2 (language of notes) x 2 (language of recall) mixed-model ANOVA. The results of this analysis yielded significance only for the language of text main effect, $F(1, 76) = 4.42$, $MS_e = 1.02$. Subjects who read the text in French were more confident in the correctness of

their responses to inference test items ($\bar{M} = 4.43$) than subjects who read the text in English ($\bar{M} = 4.10$).

Analysis of notes. Conditional probabilities of an idea unit being produced on free recall given that it had appeared in notes $P(R|N)$ were calculated in order to determine whether subjects who took notes in the alternate language from that in which text was read recalled more of those notes than subjects who read and took notes in the same language. In addition, conditional probabilities of an idea unit being produced on free recall given that it had not appeared in notes $P(R|NN)$ were calculated.

Means and standard deviations for the conditional probability of an idea unit being produced on the French version of the free recall as a function of language of text and whether or not subjects recorded the idea unit in their notes are presented in Table 3.

Insert Table 3 about here

Conditional probability data were entered into a 2 (language of text) x 2 (appearance in notes) mixed-model ANOVA. The results of this analysis yielded significance only for the appearance in notes main effect, $F(1, 38) = 102.46$, $MS_e = .02$. As expected, the probability of an idea unit being produced on free recall given that it had appeared in notes ($\bar{M} = .35$) was significantly greater than the probability of it being recalled if it had not appeared in notes ($\bar{M} = .03$).

Means and standard deviations for the conditional probability of an idea unit being produced on the English version of the free recall as a function of language of text and whether or not subjects recorded the idea unit in their notes are presented in Table 3.

Conditional probability data were entered into a 2 (language of text) x 2 (appearance in notes) mixed-model ANOVA. Results of this analysis yielded significance only for the appearance in notes main effect, $F(1, 38) = 58.89$, $MS_e = .02$. Once again, an idea unit was more likely to be produced on free recall if it had appeared in notes ($M = .27$) than if it had not ($M = .04$).

Discussion

The purpose of this study was to investigate how recall of text presented in either French or English would be influenced by having bilinguals read a passage in one language and take notes on it in their alternate language. This study, therefore, extended previous research on bilinguals' processing of text by varying the language in which an overt study strategy--notetaking--was carried out.

Contrary to expectation, varying the language in which a passage of expository text was read/encoded and recalled failed to influence either (a) the amount of information recalled by bilingual readers, or (b) their ability to draw inferences based upon what they read. First, the hypothesis that bilingual versus monolingual encoding of information presented in text would have additive effects on recall was not supported. Regardless of language of recall, overall performance of bilinguals did not vary as a function of whether the

same or different languages were used to read and take notes from text. Neither were there differences between same and different language groups in the probability that information contained in notes would transfer to recall.

The lack of a significant language of text by language of notes interaction is not consistent with previous findings demonstrating that translations of stimulus words enhance recall relative to repetition of words twice in the same language (Glanzer & Duarte, 1971; Paivio & Lambert, 1981). Perhaps, as implied by previous research findings, the importance of language of presentation as an attribute of stimulus encoding varies inversely with the connectedness and meaningfulness of the test stimuli (Rose et al., 1975; Rosenberg & Simon, 1977; Saegert, Hamayan, & Ahmar, 1975). That is, in the case of single words, translation of a subset of the stimuli likely heightens their discriminability relative to simple repetition, thereby producing enhanced recall. On the other hand, when stimuli are linguistically complex, subjects probably turn their attention to processing underlying meaning, and in turn, pay less attention to surface structure. Language of presentation as an attribute of encoding, therefore, declines in importance.

Second, results of the present study failed to support the prediction that subjects who read and were tested in the same language would perform better on both dependent measures than their counterparts who read the text in one language and were tested in their alternate language. These results are similar to those reported by previous

researchers who examined bilinguals' recall of complex verbal material as a function of language of presentation and recall (Keats & Keats, 1974; Kolers, 1966), and provide additional support for Kolers' contention that "the linguistic form of connected discourse has only a trivial effect on comprehension of text" (p. 361).

Interestingly, while the results of this study provide no support for Ojerinde's (1982) conclusion that bilinguals tend to actually remember more from texts favoring their native syntax, there was a main effect for level of confidence in correctness of responses to items on the inference test. Subjects in this study believed that they remembered more when text was presented in their native language (French) as opposed to their second language, although, in fact, performance on the French and English versions of this test did not differ significantly.

Based on the dual coding, independence model of bilingual memory (Paivio & Lambert, 1981), it was expected that reading text in one language and taking notes in another language would have beneficial effects on recall. Since these effects were not observed in this study, the results cannot be marshalled to support the independence model of bilingual memory. Instead, it appears that a single, modality-independent representation in memory is produced when related ideas are encountered in two languages. That is, the same ideas expressed in two different languages are not bifurcated into two semantic components, but rather are stored as a unified semantic

component. These findings are basically in accord with previous findings on bilinguals of a single, semantic storage of concepts in memory.

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Table 1

Means and Standard Deviations for Proportion of Idea
Units Produced on Free Recall and Number of Items
Correct on Inference Test as a Function of
Language of Text, Notes, and Recall

Language of Text	Language of Notes	Language of Recall	Test	
			Free Recall	Inference
French	French	M	.09	3.90
		SD	.06	1.12
		M	.08	4.10
		SD	.04	.91
	English	M	.11	4.00
		SD	.04	.92
		M	.09	3.95
		SD	.06	1.00
English	French	M	.09	3.80
		SD	.06	1.15
		M	.09	3.45
		SD	.06	1.36
	English	M	.08	3.75
		SD	.04	1.12
		M	.08	3.70
		SD	.04	.98

Table 2

Means and Standard Deviations for Mean Confidence
Rating on Inference Test as a Function of
Language of Text, Notes, and Recall

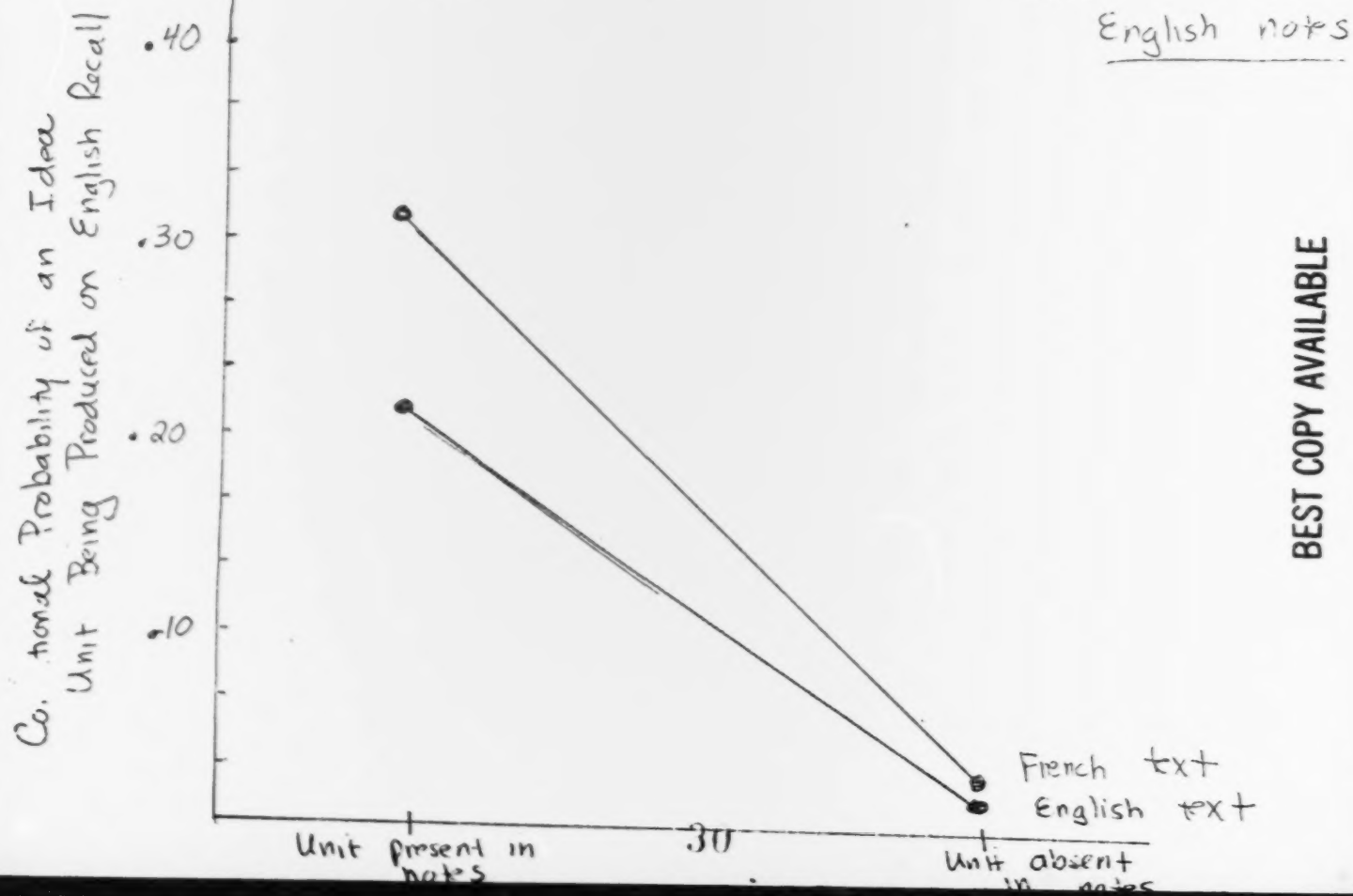
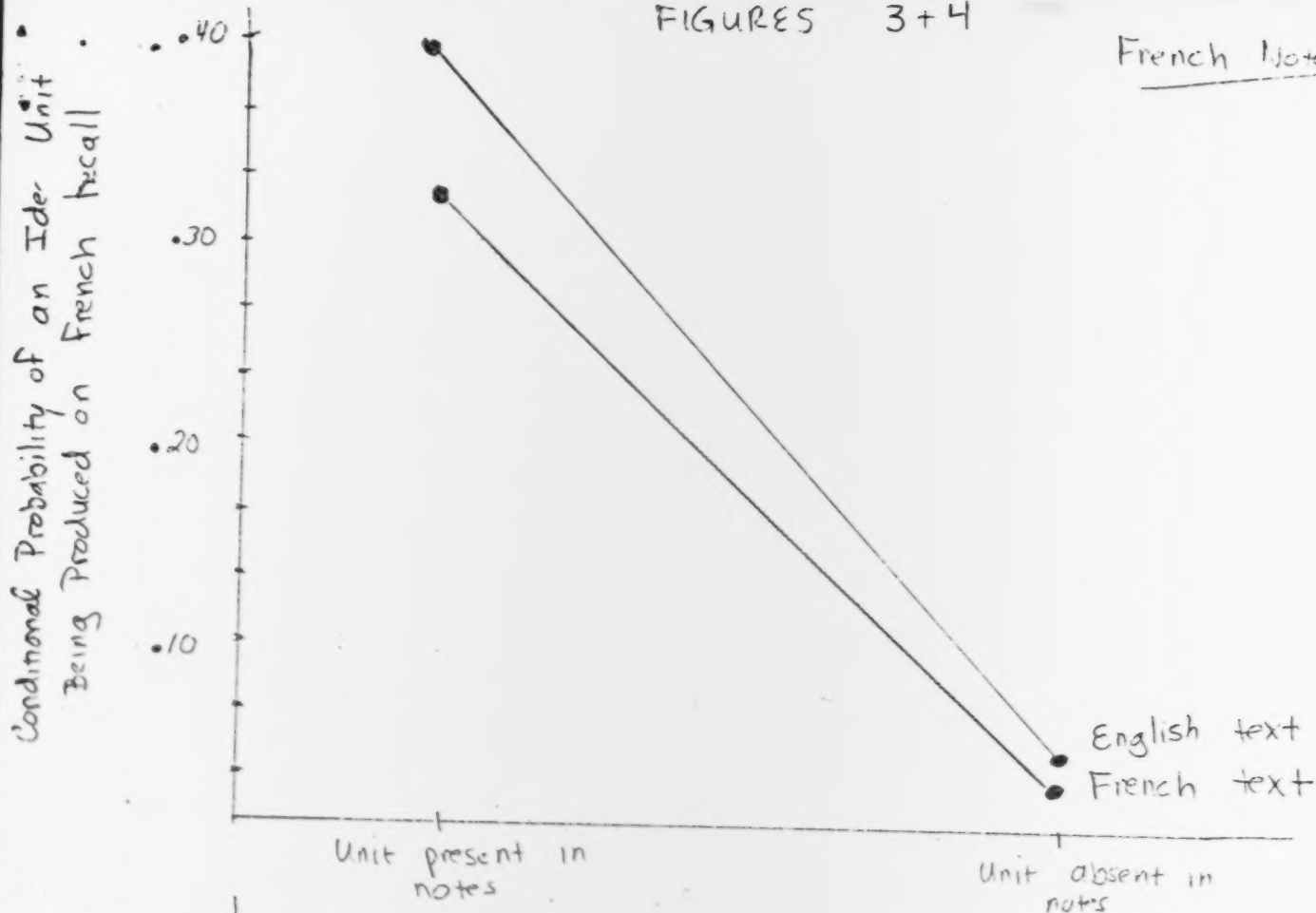
Language of Text	Language of Notes		Language of Recall	
			French	English
French	French	M	4.12	4.22
		SD	.60	.72
	English	M	4.61	4.69
		SD	.62	.57
English	French	M	3.97	4.08
		SD	.78	.88
	English	M	4.20	4.16
		SD	.80	.96

Table 3
Means and Standard Deviations for Conditional
Probabilities of an Idea Unit Being Produced
on French and English Free Recalls as a
Function of Language of Text and
Appearance in Notes

Language of Notes	Language of Text		Appearance in Notes	
			Yes	No
French	French	M	.32	.03
		SD	.21	.02
	English	M	.38	.04
		SD	.18	.03
English	French	M	.31	.04
		SD	.19	.04
	English	M	.22	.03
		SD	.19	.03

FIGURES 3+4

French Notes



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